



Web Service-based Vegetation Condition Monitoring System - VegScape

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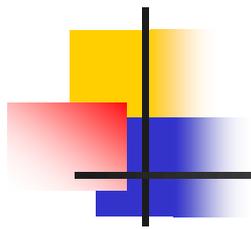
Project Goals

- Improve the science, objectivity, robustness and defensibility of nationwide crop vegetation condition monitoring operation at NASS
- Develop an operational National Crop Condition Monitoring System (NCCMS) - VegScape
- Produce crop vegetation condition data products that are complementary to existing NASS crop condition products.
- Enhance data accessibility, interoperability, online analytics, and dissemination.
- => Meet user's requirements.



Why Do We Need A New Crop Vegetation Condition System?

- AVHRR sensor
 - AVHRR 17 – Dead;
 - AVHRR 18 – Aging, and not consistent with AVHRR 17.
 - Low spatial resolution (1km)
 - Low temporal resolution (biweekly)
- NASS weekly publishes NDVI low resolution static map; NASS needs:
 - better spatial and temporal resolutions;
 - data processing and web publishing automation;
 - better visualization and data dissemination;
 - vegetation condition analytics & assessment.



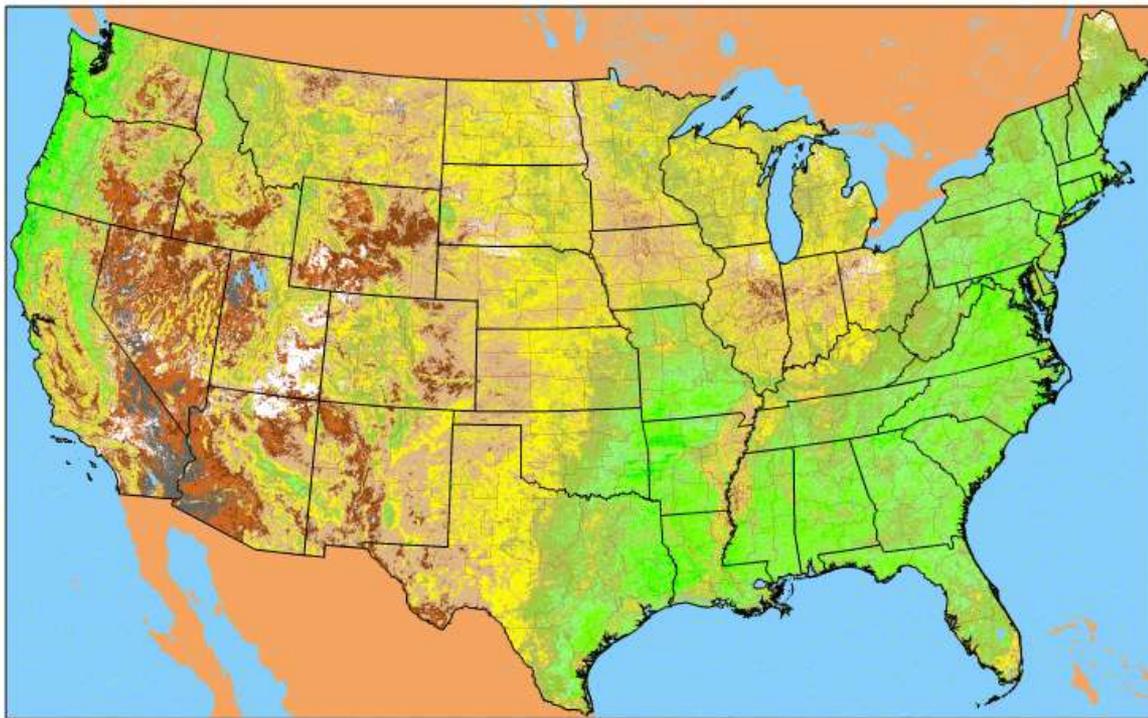
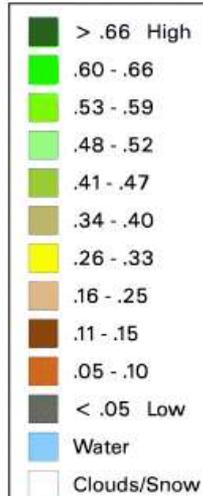
OLD VEGETATION MONITORING

Static Crop Condition Image (NDVI)

Conterminous U.S. Vegetation Condition - 2010
Period 43 (10/12 - 10/25)

No Water Vapor
Correction Applied

Vegetation Index



Agricultural Statistics Districts

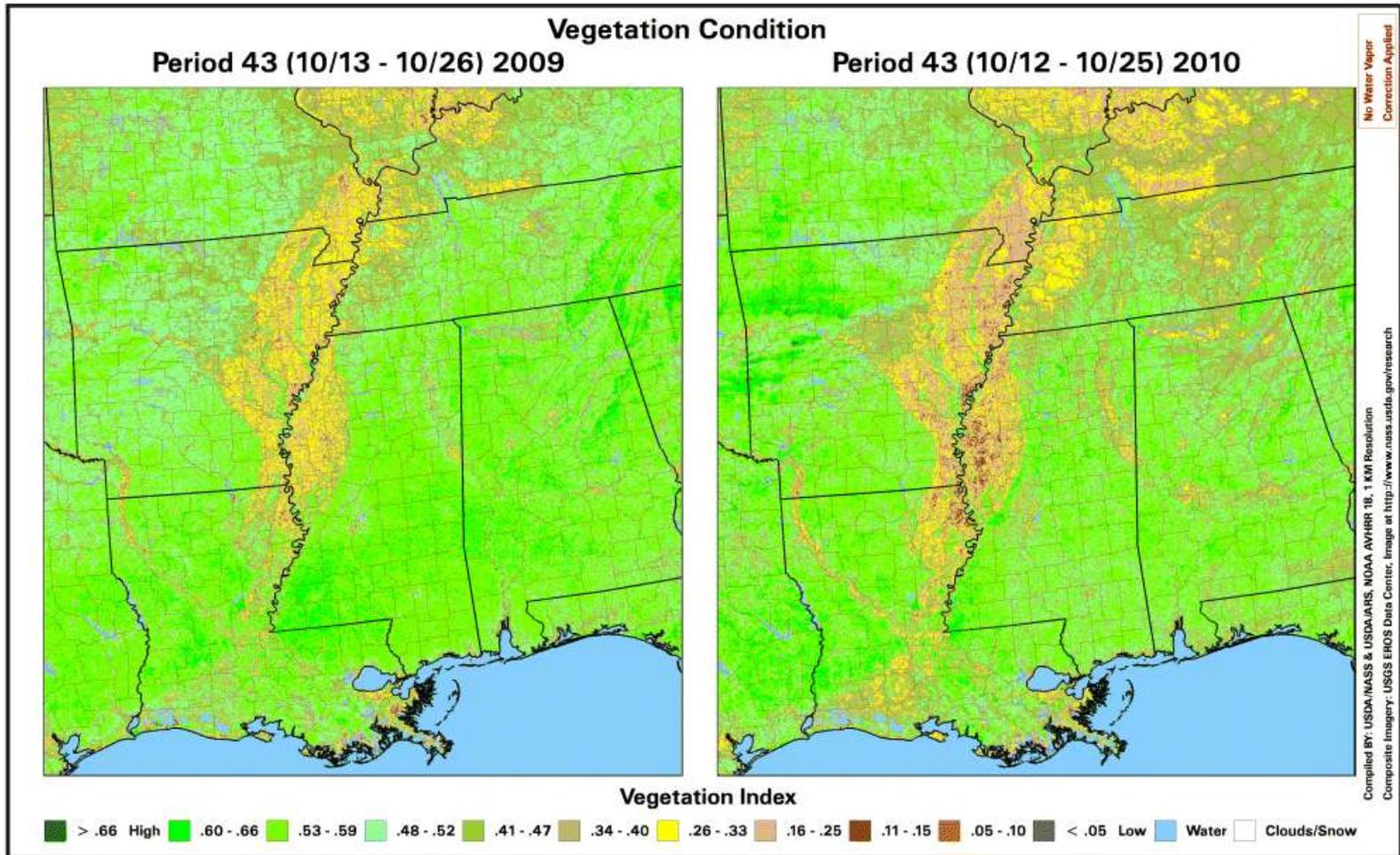
1:15,000,000

Original Imagery: NOAA-18 AVHRR
Resolution: 1 Kilometer
Composite Imagery: USGS EROS Data Center
Questions email: hq_rtd_gib@nass.usda.gov

For Additional Images Please See:
www.nass.usda.gov/research

0 100 200 300 400 500 Miles

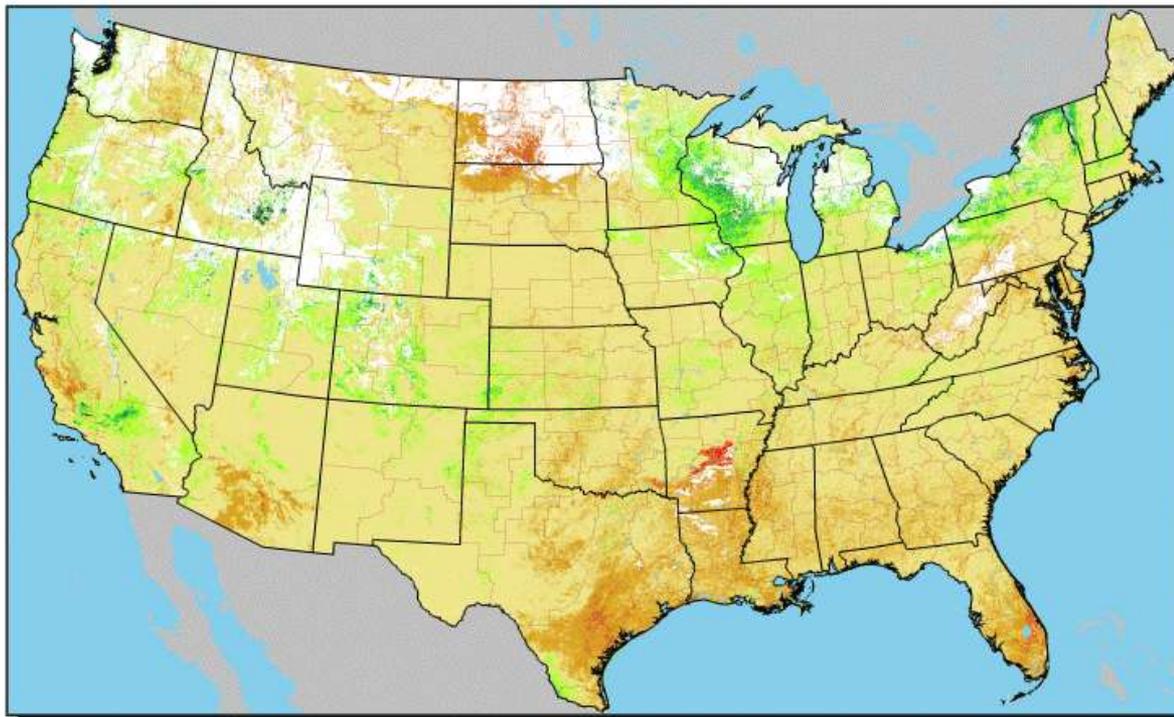
Yearly Comparison (Ratio to Previous Year)



Ratio Comparison to Previous Year in Percent

Vegetation Condition Percent Change: 2009 ÷ 2008
Period 12 (3/10 - 3/23)

No Water Vapor
Correction Applied



Percent Change

- < = -25%
- < = -15%
- < = -5%
- +/-
- > = +5%
- > = +15%
- > = +25%
- Clouds/Snow

Agricultural Statistics Districts
1:15,000,000

Original Imagery: NOAA-17 AVHRR
Resolution: 1 Kilometer
Composite Imagery: USGS ERDS Data Center
Questions email: hq_rdd_gib@nass.usda.gov

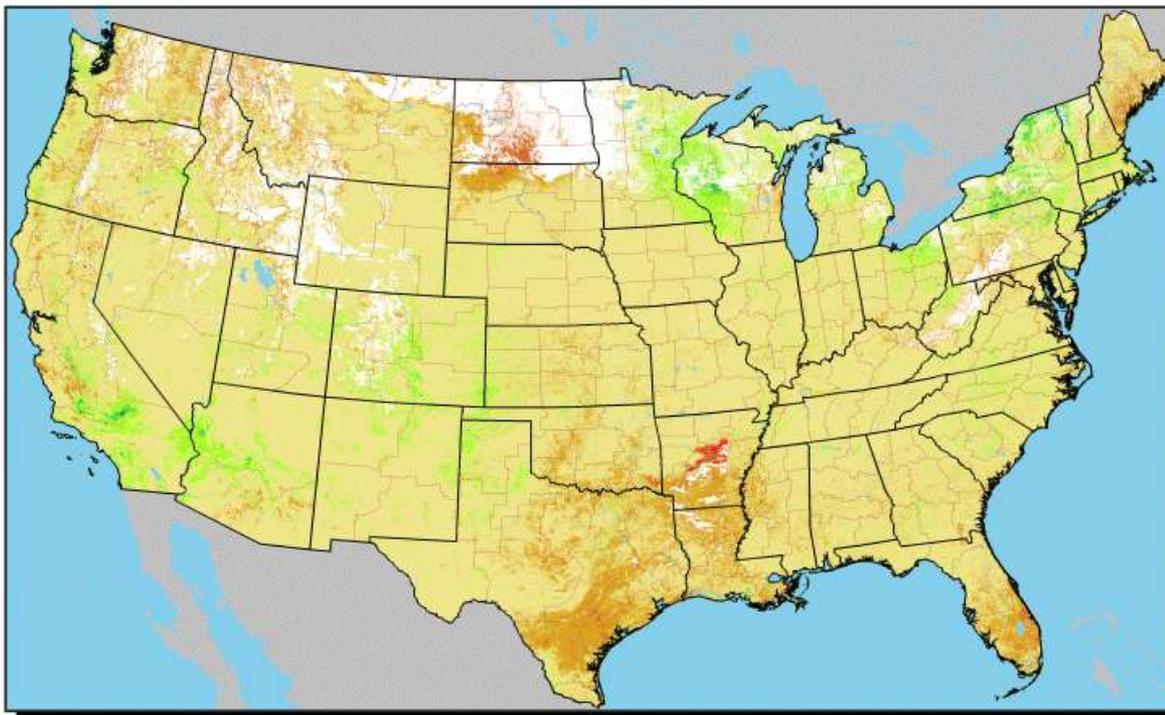
For Additional Images Please See:
<http://www.nass.usda.gov/research>
To Download Raw Images:
<http://www.nass.usda.gov/research/avhrr/scene.html>

0 100 200 300 400 500 Miles

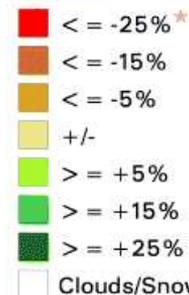
Percent Change Ratio to Median

Vegetation Condition Percent Change: 2009 ÷ Median (2004 → 2008)
Period 12 (3/10 - 3/23)

No Water Vapor
Correction Applied



Percent Change



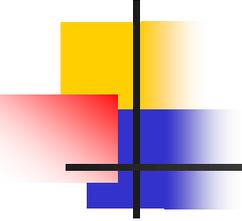
* Variations in Snow Cover May Unduly Influence this Category

Agricultural Statistics Districts

1:15,000,000

Original Imagery: NOAA-17 AVHRR
Resolution: 1 Kilometer
Composite Imagery: USGS EROS Data Center
Questions email: hq_r01_glb@nass.usda.gov

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To Download Raw Images:
<http://www.nass.usda.gov/research/avhrr/scene-ftp/>



VegScape Design & Implementation



User's Major System Requirements

- Interactive vegetation condition mapping.
- Pixel-level level granularity.
- On-the-fly data processing and presentation.
- Online analytics within user defined region.
- Geospatial query capability.
- Crop specific vegetation condition information.
- Equal accession and dissemination via spatially enabled Web-based system to facilitate equal information access.

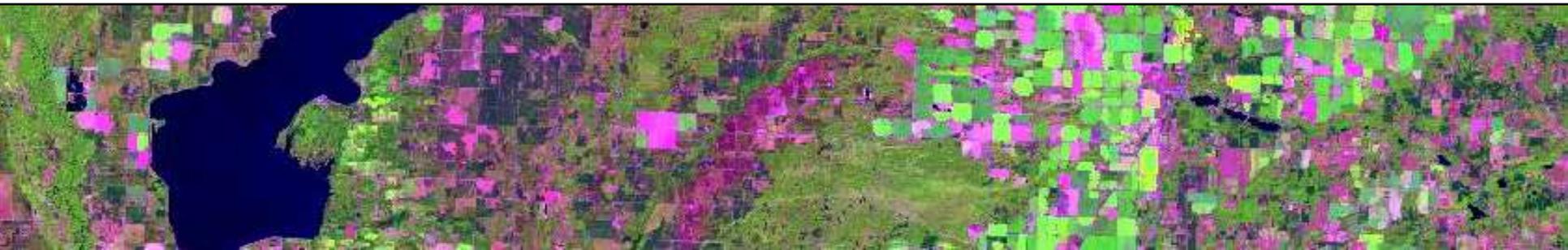


New Vegetation Condition Monitoring System - VegScape

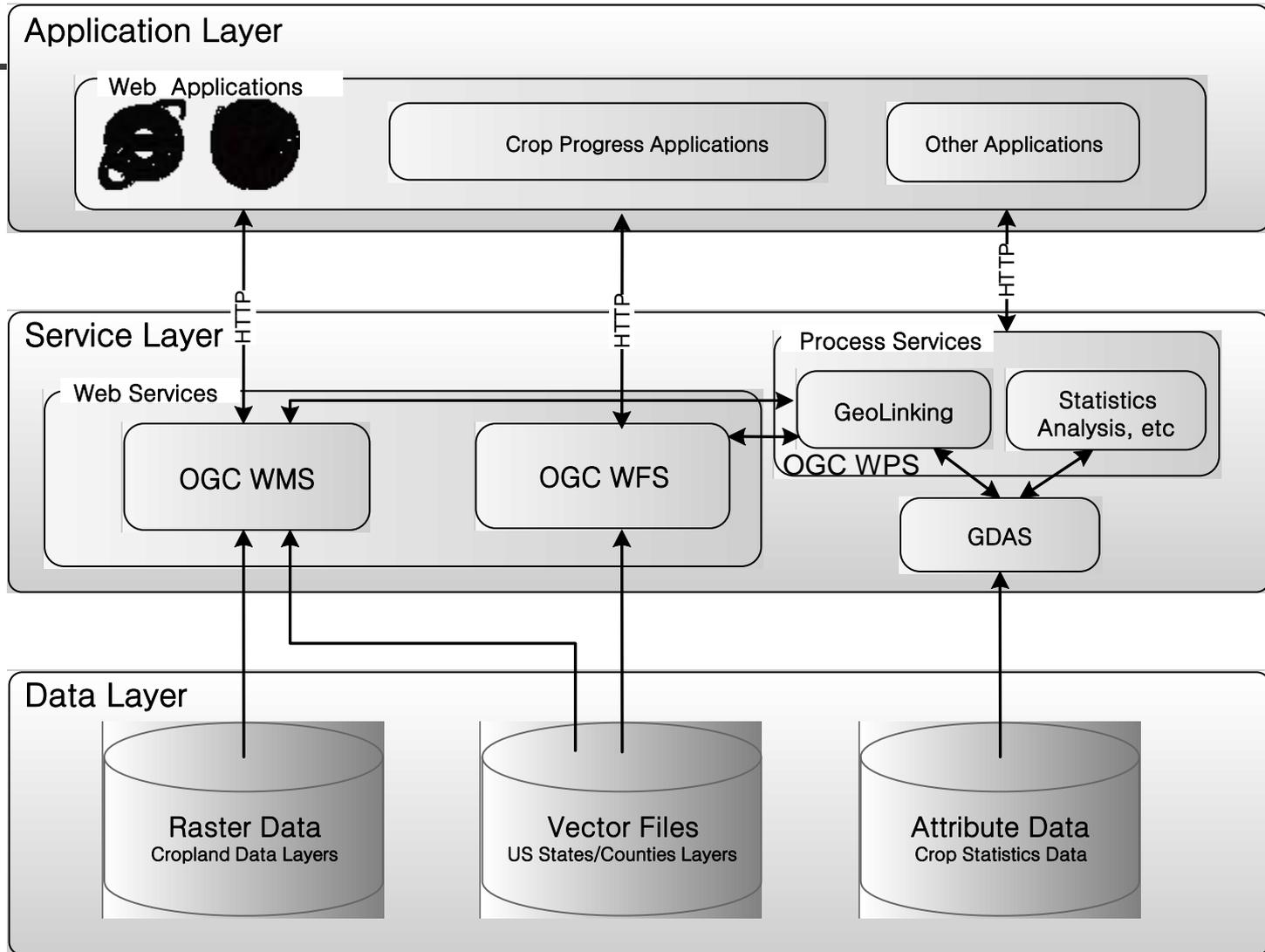
- Different sensor - MODIS
 - Daily repeat => weekly composite
 - 250 meter spatial resolution;
 - Rich cloud pixel information and better preprocessing;
- GIS technology provides
 - Web-based interactive mapping
 - Various online capabilities: online navigation, zooming, panning, downloading, or on-the-fly processing, online statistics, data profiling, etc.
- VegScape provides
 - Data retrieving and processing automation
 - Web publishing and dissemination automation
 - Irregular, ad-hoc data retrieving and processing for emergency assessment or reporting
 - Objective historical data comparison for crop condition assessment
 - Various vegetation condition metrics;
 - Crop land focused, or even crop specific monitoring;
- VegScape reuses the same geo-information technology as CropScape

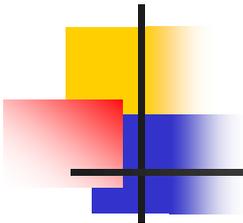
Considerations of Architecture Design and Technology

- Web Based Service Oriented Architecture
- OGC standard compliant web services:
 - Web Feature Service (WFS), Web Map Service (WMS), Web Processing Service (WPS), Sensor Observation Service (SOS), etc.
- Service Integration
 - Support of workflows: Business Process Execution Language (BPEL), BPEL execution engine
 - Re-use all algorithms published in WPS
- Re-use functions/algorithms already developed



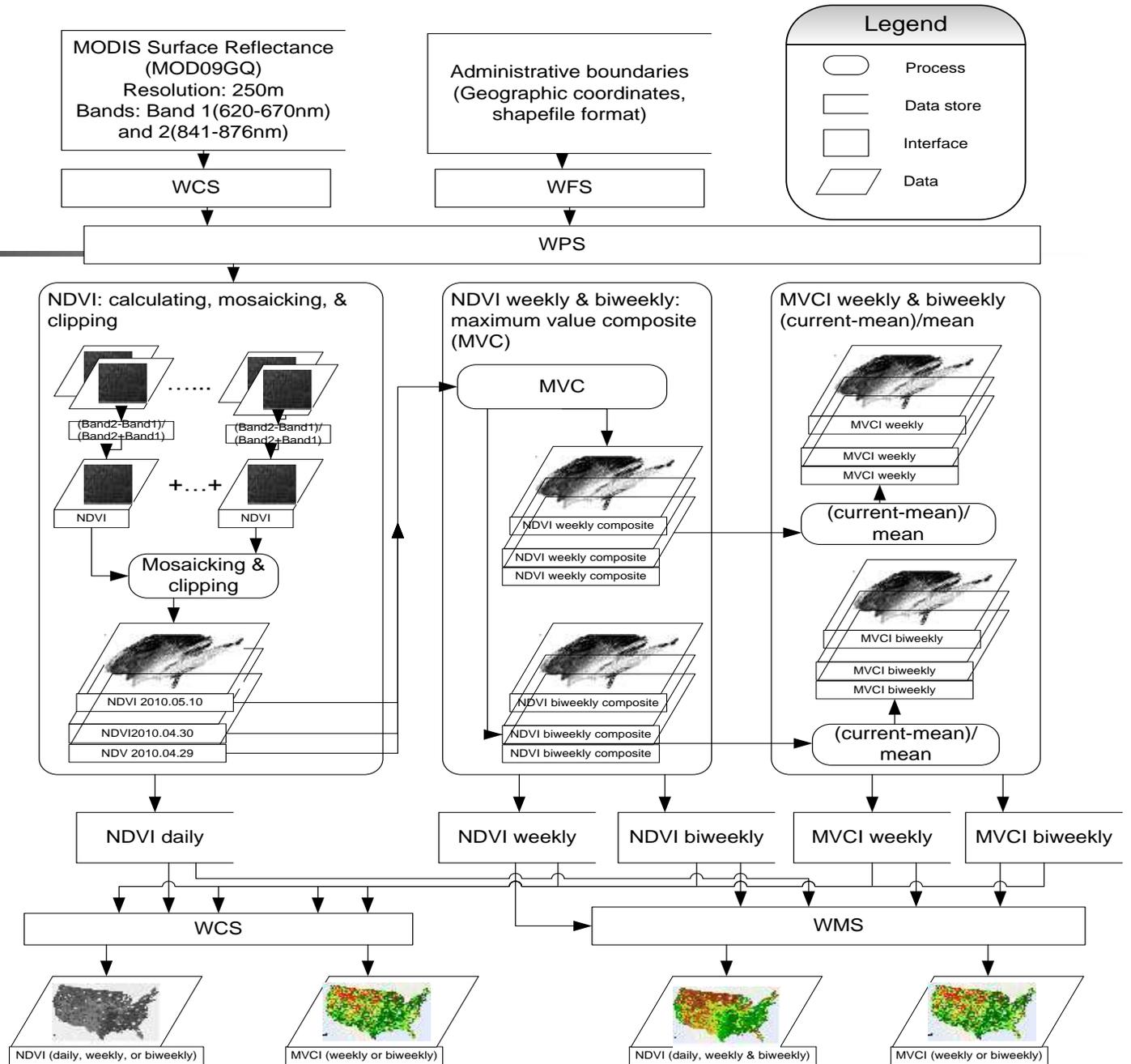
Service-Oriented Architecture (SOA)





Data processing

Data processing flow for vegetation index calculation.





Vegtation Condition Indices

$$NDVI = (IR - R) / (IR + R)$$

$$MVCI = \frac{NDVI(x, y) - NDVI_m(x, y)}{NDVI_m(x, y)} \times 100$$

$$RMNDVI = \frac{NDVI_i(x, y) - NDVI_{med}(x, y)}{NDVI_{med}(x, y)} \times 100\%$$

$$RPNDVI = \frac{NDVI_i(x, y) - NDVI_{i-1}(x, y)}{NDVI_{i-1}(x, y)} \times 100\%$$

$$VCI = \frac{NDVI(x, y) - NDVI_{min}(x, y)}{NDVI_{max}(x, y) - NDVI_{min}(x, y)} \times 100\%$$

VegScape – Browser Client

The screenshot shows the VegScape web application running in a browser. The interface includes a header with logos for USDA, National Agricultural Statistics Service, and NASA. Below the header is a navigation bar with 'Layers', 'Products', and 'Legends' tabs. A central map window displays a satellite-style map of the United States with NDVI data overlaid. A legend on the right side of the map provides a color key for NDVI values. A tool bar is located above the map, and an overview window is in the bottom left corner. The browser's address bar shows the URL 'http://nassgeodata.gmu.edu/VegScape/'.

Data Layers

Product Selection

Legends

Tool Bar

Map window

Overview Window

Legend

Dark Green	> 0.89
Green	0.79 - 0.89
Light Green	0.69 - 0.79
Yellow-Green	0.59 - 0.69
Yellow	0.49 - 0.59
Light Yellow	0.39 - 0.49
Yellow-Orange	0.29 - 0.39
Orange	0.19 - 0.29
Dark Orange	0.10 - 0.19
Brown	0.05 - 0.10
Dark Brown	< 0.05
White	No Data

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Weekly_NDVI_26_2012.06.26_2012.07.02

VegScape – Tool Bar

- Zoom in
- Zoom out
- Pan
- Drag zoom
- Home
- Refresh
- Previous View
- Next view
- Identify pixel value
- Define state/county AOI
- Define rectangle AOI
- Import AOI
- Swipe layer
- Download AOI
- Clear AOI
- Show/hide legend
- Statistics
- Profile



VegScape – Layers, Products and Legends

USDA United States Department of Agriculture
National Agricultural Statistics Service

Layers Products Legends

- Basic Layers
 - Global Cover
- CDL
 - CDL 2012
 - Crop Mask
- Boundaries
 - Counties
 - States
 - ASD
- Water Layers
 - Rivers
 - Lakes
- Road Layers
 - Freeway System (National)
 - Major Highways (Regional)
- NDVI Layers
 - Weekly_NDVI_11_2013.03

Data Layers

USDA United States Department of Agriculture
National Agricultural Statistics Service

Layers Products Legends

Type: NDVI
Period: Weekly
Year: 2013
Date: 11(03.12_03.18)_2013

- 01(01.01_01.07)_2013
- 02(01.08_01.14)_2013
- 03(01.15_01.21)_2013
- 04(01.22_01.28)_2013
- 05(01.29_02.04)_2013
- 07(02.12_02.18)_2013
- 08(02.19_02.25)_2013
- 10(03.05_03.11)_2013
- 11(03.12_03.18)_2013

Product Selection

USDA United States Department of Agriculture
National Agricultural Statistics Service

Layers Products Legends

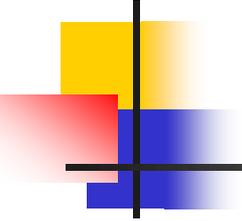
NDVI Data Layer:

- > 0.89
- 0.79 - 0.89
- 0.69 - 0.79
- 0.59 - 0.69
- 0.49 - 0.59
- 0.39 - 0.49
- 0.29 - 0.39
- 0.19 - 0.29
- 0.10 - 0.19
- 0.05 - 0.10
- < 0.05
- No Data

VCI Data Layer:

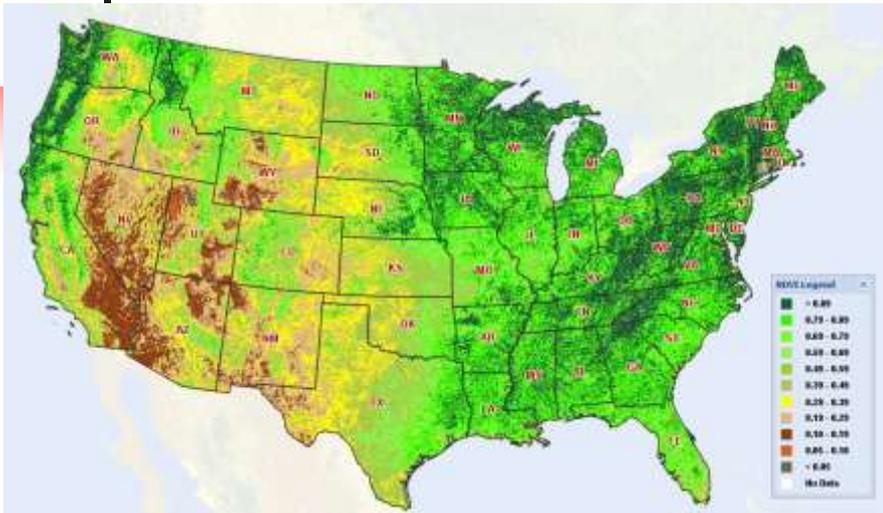
- 0.82 - 1.00
- 0.71 - 0.82
- 0.59 - 0.71
- 0.47 - 0.59

Legends

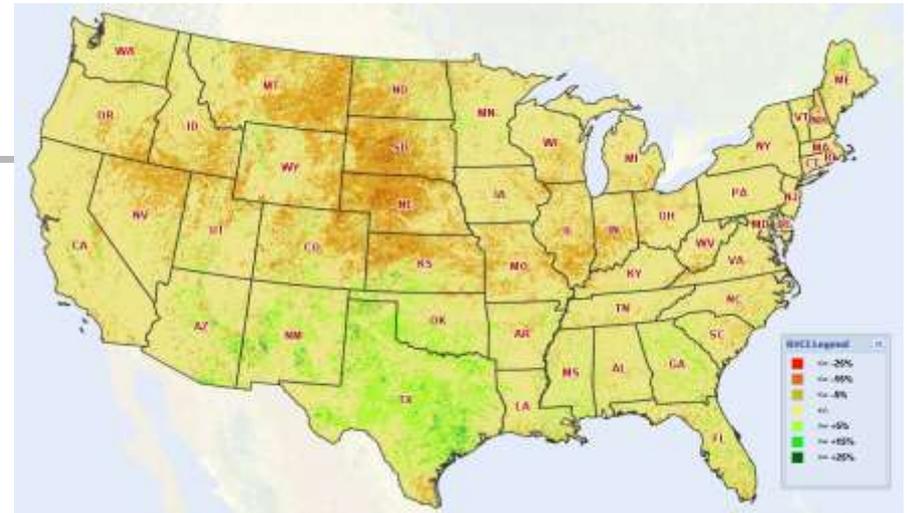


VegScape Function Highlight

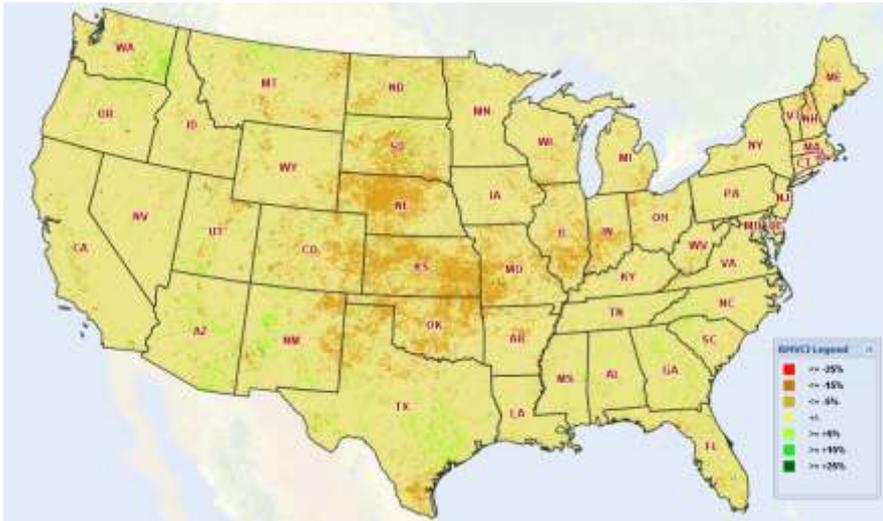
Weekly Vegetation Indices 07/24/12 – 07/30/12



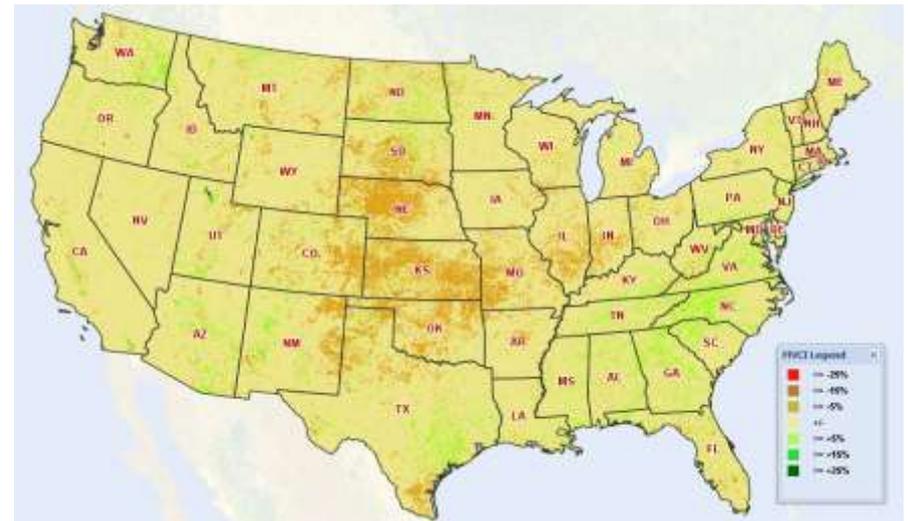
NDVI



NDVI Ratio to Previous Year



NDVI Ratio to Median



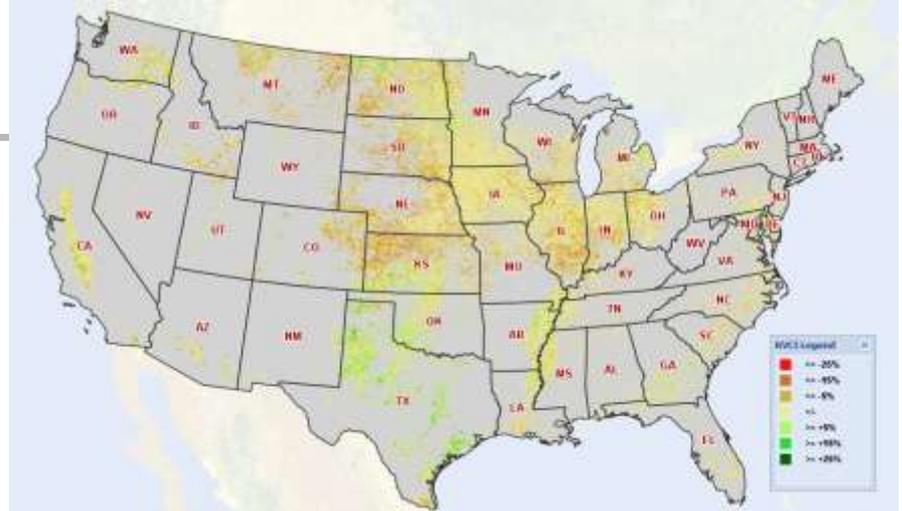
NDVI Ratio to mean

Weekly Vegetation Indices 07/24/12 – 07/30/12

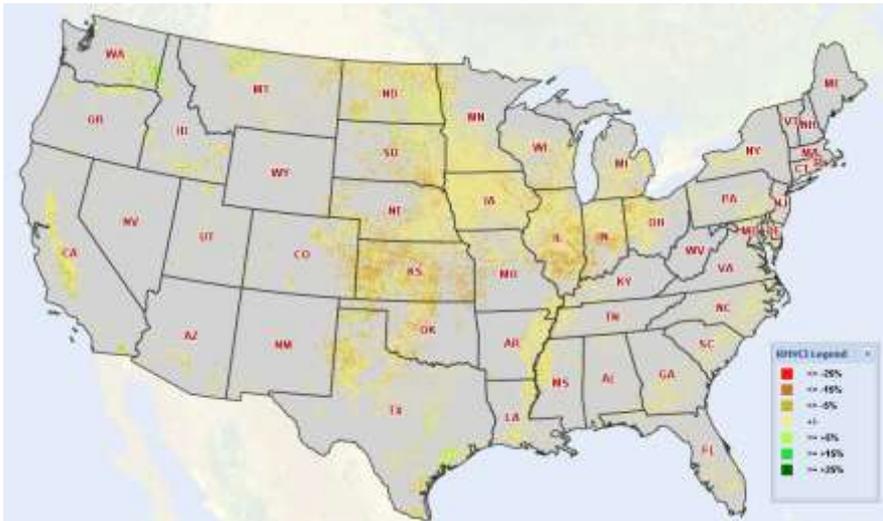
Crop Mask Applied



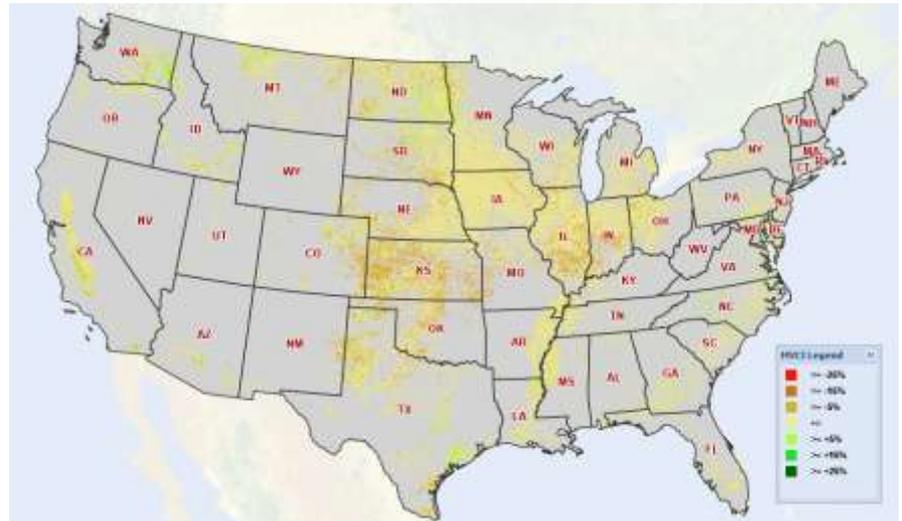
NDVI



NDVI Ratio to Previous Year



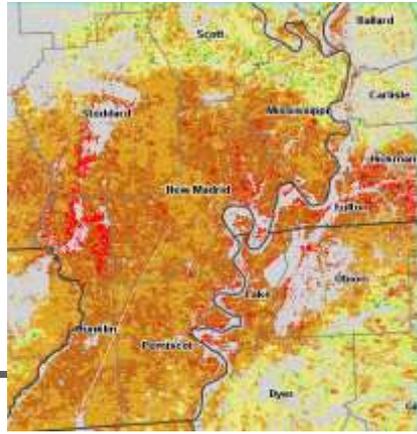
Ratio Median NDVI or RMVCI



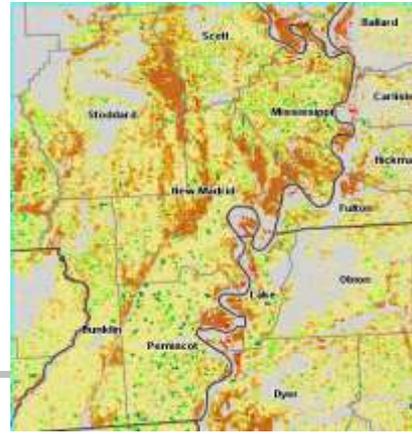
Mean NDVI or MVCI



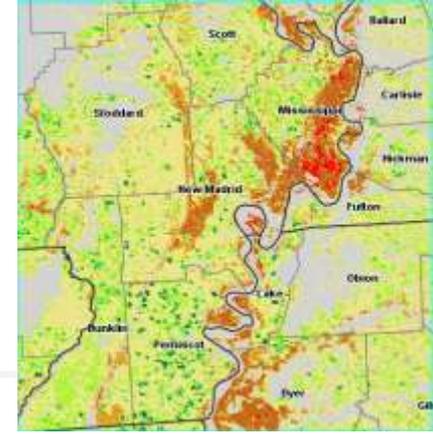
04/12-04/18/11



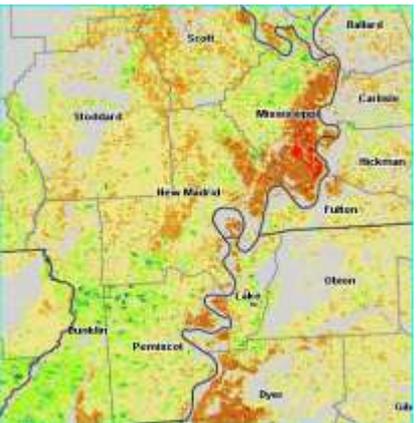
04/19-04/25/11



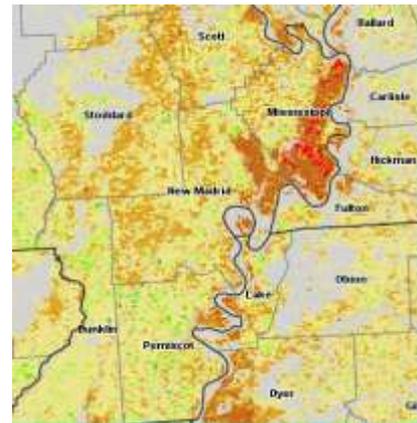
04/26-05/02/11



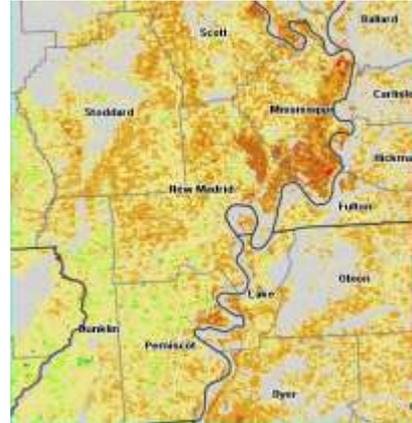
05/03-05/09/11



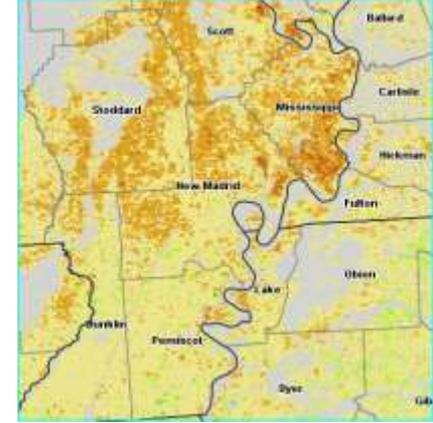
05/10-05/16/11



05/17-05/23/11



05/24-05/30/11

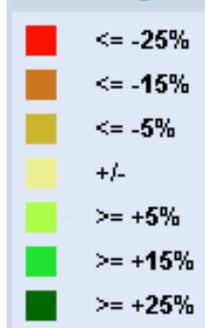


05/31-06/06/11



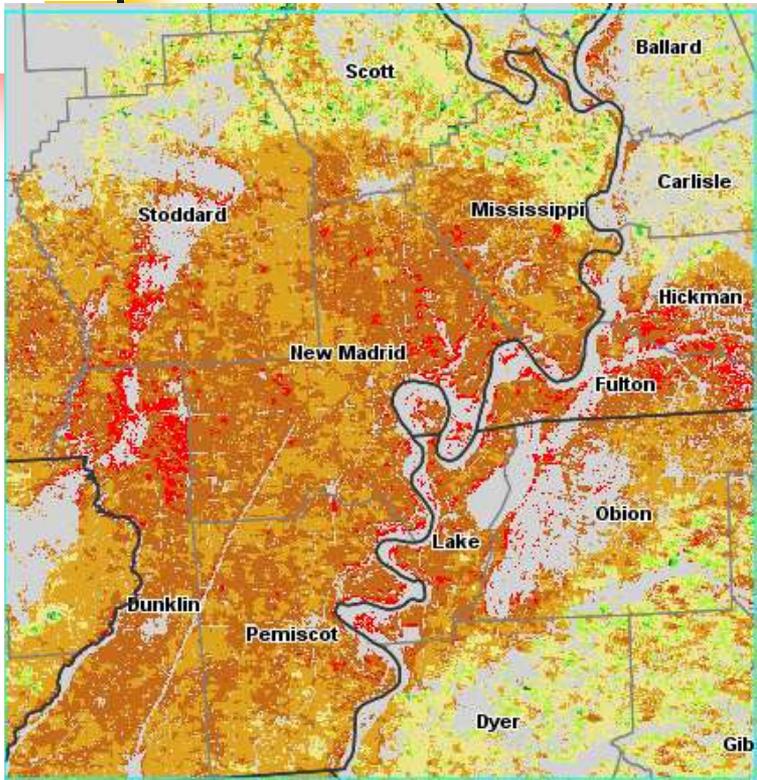
Cropland
Data
Layer

RMVCI Legend



2011 Flood Missouri Bootheel
NDVI Ratio to Median
(Median of 10 years NDVI)

AOI Statistics - Ratio to Median VCI



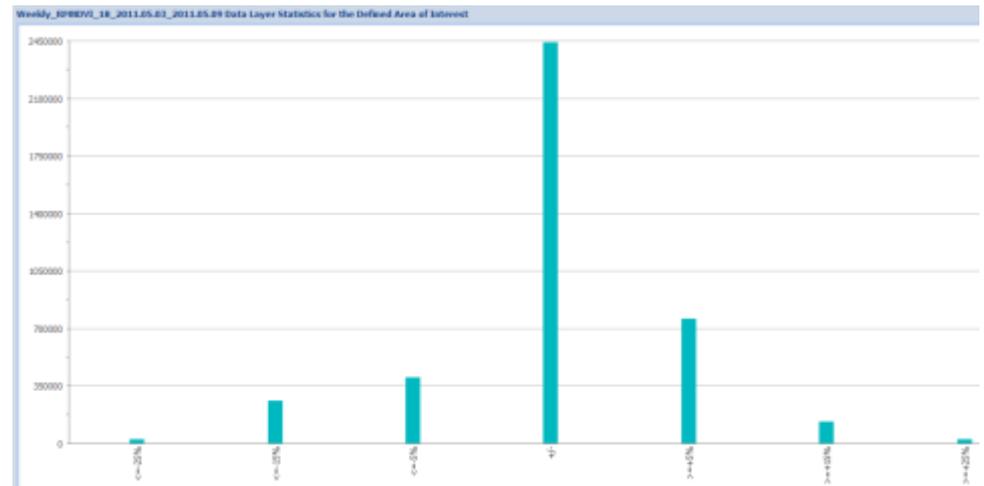
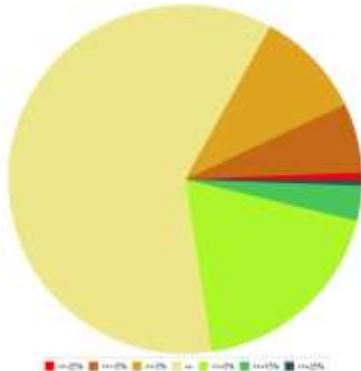
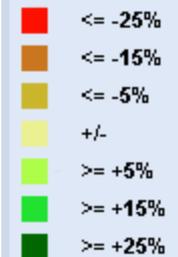
Weekly_RMNDVI_18_2011.05.03_2011.05.09 Data Layer Statistics for the Defined Area of Interest

Note: Pixel and acreage counts are not official estimates.

Value	Category	Pixel Counts	Acreage
0	<=-25%	1931	25606.6
1	<=-15%	19647	260535.3
2	<=-5%	30411	403274.7
3	+/-	184180	2442377.2
4	>=+5%	57280	759579.6
5	>=+15%	9910	131414.7
6	>=+25%	1765	23405.3
Total	7	305124	4046193.4

04/19-04/25/11
Quantify vegetative area condition

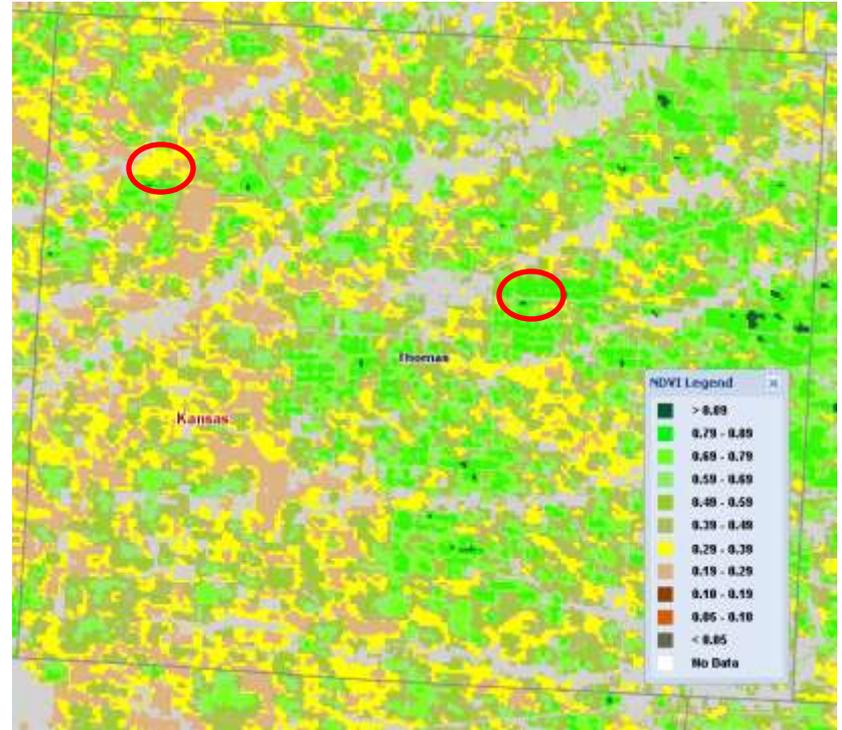
RMVCI Legend



VegScape Serves 2012 CDL by Using CropScape Web Service

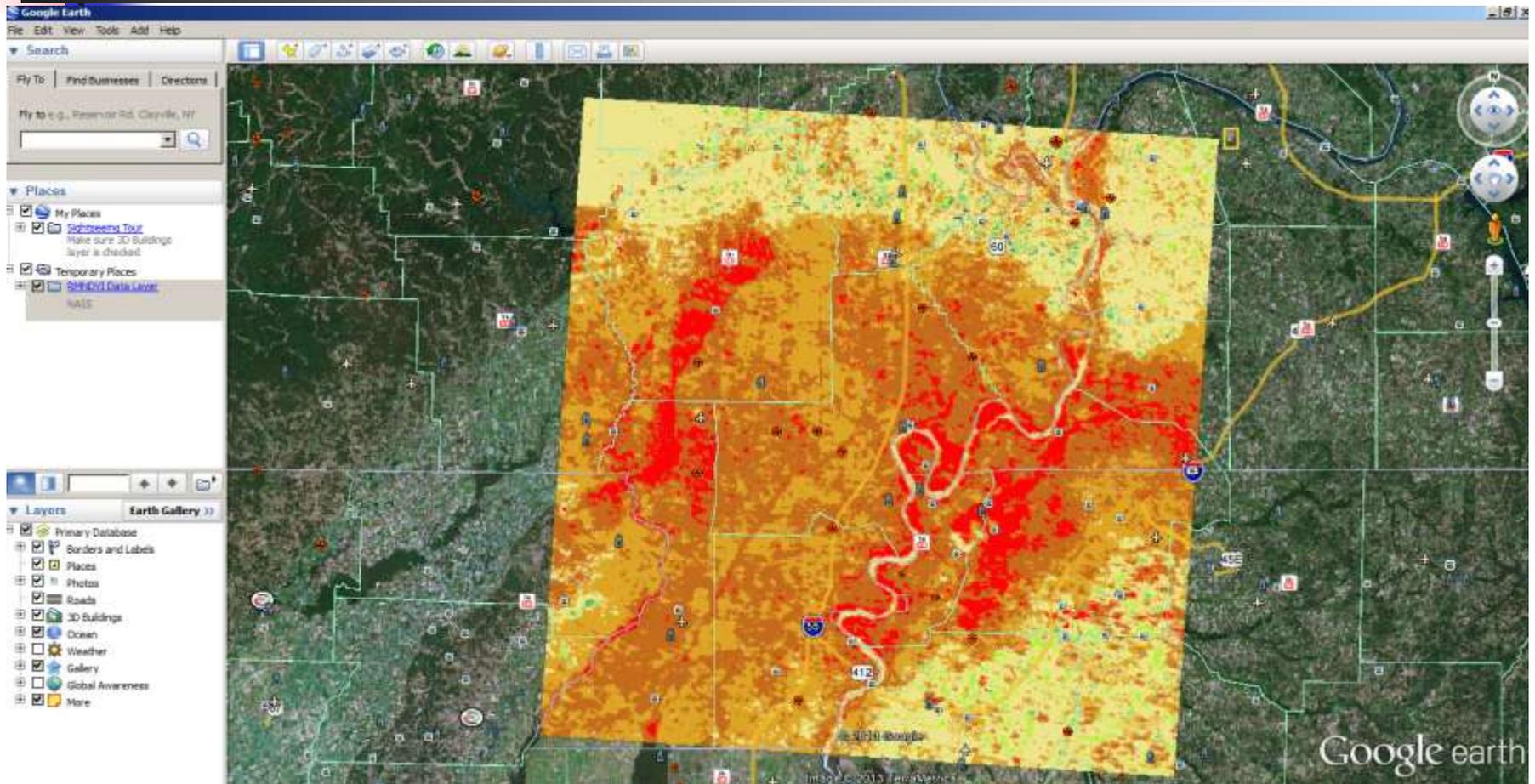


2012 Cropland Data Layer
The 2012 Cropland Data Layer (CDL) product depicts land cover



7/24/12 – 7/30/12 NDVI
Vegetative condition indicates crops under stress from the 2012 drought

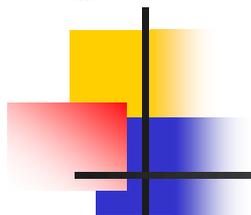
Data Mashup with Google Earth



Export any selected index data directly into **Google Earth**

Conclusions

- MODIS offers high spatial/temporal resolution & data continuity
- Web-based dynamic interactive mapping
 - Dynamic maps of Multi vegetation condition indices
 - Online navigation, zooming, panning, downloading, on-the-fly processing
 - Online analytics: Statistical analysis and change comparison
 - Automatic data retrieval, processing, publishing, and dissemination
- Irregular, ad-hoc data retrieval and processing for emergency assessment/reporting
- Assessing crop condition and identifying the areal extent of floods, drought, major weather anomalies, and vulnerabilities of early/late season crops
- Consider VegScape operational upon start of 2013 growing season!
- Unfinished business:
 - Further refine data processing algorithms to improve performance and quality;
 - Finish implementing and deploring web services.
 - Further enhancing and adding more functionalities

A decorative graphic consisting of overlapping yellow, red, and blue squares with a black crosshair.

Questions & Comments?

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